WHAT IS CLAIMED IS:

1. A multi-wavelength optical transmitter for multiplexing a plurality of channels having different wavelengths into an optical signal so as to output the multiplexed optical signal, the multi-wavelength optical transmitter comprising:

a plurality of lasers for generating, by corresponding incoherent light received in the lasers, a plurality of mode-locked channels having different wavelengths;

a multiplexer/demultiplexer for multiplexing the plural channels into an optical signal for output; and

a semiconductor optical amplifier (SOA) for amplifying the outputted optical signal in a gain saturation state.

2. The multi-wavelength optical transmitter as claimed in claim 1, further comprising:

a broadband light source for generating light having a wide wavelength band including a plurality of incoherent lights having different wavelengths; and

a circulator for outputting the multiplexed optical signal to the SOA, and sending light that is outputted from the broadband light source to the multiplexer/demultiplexer,

wherein the multiplexer/demultiplexer demultiplexes said light that is outputted from the broadband light source into a plurality of incoherent lights having different wavelengths so as to output the demultiplexed incoherent light among the lasers.

3. The multi-wavelength optical transmitter as claimed in claim 2, wherein the broadband light source includes an Erbium-doped fiber amplifier.

4. The multi-wavelength optical transmitter as claimed in claim 1, wherein the multiplexer/demultiplexer includes an arrayed waveguide grating.

5. The multi-wavelength optical transmitter as claimed in claim 1, wherein the lasers include a Fabry-Perot laser for generating a respective mode-locked channel by incoherent light.

6. A bi-directional wavelength division multiplexing system comprising a central office for outputting a downstream optical signal comprised of downstream channels and for receiving upstream channels, a plurality of subscriber terminals for receiving said downstream channels and outputting said upstream channels, and a remote node for relaying optical communication between the central office and the subscriber terminals, wherein the central office includes:

a multiplexer/demultiplexer for demultiplexing an upstream optical signal into said upstream channels so as to output the demultiplexed channels, and multiplexing a plurality of downstream channels having different wavelengths into said downstream optical signal so as to output the multiplexed optical signal;

a plurality of photodetectors for detecting each of said upstream channels demultiplexed by the multiplexer/demultiplexer;

a plurality of lasers for generating mode-locked downstream channels by corresponding incoherent light received in the lasers, and outputting the generated downstream channels to the multiplexer/demultiplexer;

a semiconductor optical amplifier for amplifying the upstream optical signal to be demultiplexed and the downstream optical signal to be outputted by the central office, which are received in the semiconductor optical amplifier in a gain saturation state, so as to output the amplified upstream optical signal to the multiplexer/demultiplexer and so as to output the amplified downstream optical signal to the remote node; and

a plurality of wavelength selection couplers for outputting ones of said upstream channels, which are outputted from the multiplexer/demultiplexer, to corresponding photodetectors, outputting corresponding incoherent light to corresponding lasers, and outputting said downstream channels, which are outputted from the lasers, to the multiplexer/demultiplexer.

7. The bi-directional wavelength division multiplexing system as claimed in claim 6, wherein the central office further comprises:

a downstream broadband light source for outputting downstream light having a wide wavelength band including a plurality of incoherent lights having different wavelengths;

an upstream broadband light source for outputting upstream light having a wide wavelength band including a plurality of incoherent lights having different wavelengths;

a circulator located between the multiplexer/demultiplexer and the SOA, for

outputting the upstream optical signal and downstream light to the multiplexer/demultiplexer, and for outputting the downstream optical signal and upstream light to the semiconductor optical amplifier;

a first band pass filter (BPF) located between the downstream broadband light source and the circulator, for reflecting an upstream optical signal received in the first BPF to the circulator, and for transmitting downstream light to the circulator; and

a second BPF located between the upstream broadband light source and the circulator, for reflecting a downstream optical signal received in the second BPF to the circulator, and for transmitting upstream light to the circulator,

wherein the multiplexer/demultiplexer demultiplexes downstream light into a plurality of incoherent lights having different wavelengths so as to output demultiplexed light to each of the wavelength selection couplers.

8. The bi-directional wavelength division multiplexing system as claimed in claim 7, wherein the downstream broadband light source uses an Erbium doped fiber amplifier outputting spontaneous emission light in a wavelength band of 1550 nm.

9. The bi-directional wavelength division multiplexing system as claimed in claim 7, wherein the upstream broadband light source uses an Erbium doped fiber amplifier outputting spontaneous emission light in a wavelength band of 1310 nm.

10. The bi-directional wavelength division multiplexing system as claimed in claim 6, wherein the lasers include Fabry-Perot lasers.

11. The bi-directional wavelength division multiplexing system as claimed in claim 6, wherein the remote node includes a multiplexer/demultiplexer for multiplexing said upstream channels outputted from each of the subscriber terminals into said upstream optical signal for output to the central office, demultiplexing upstream light outputted from the central office into a plurality of incoherent lights having different wavelengths so as to output the demultiplexed upstream light to a corresponding subscriber terminal, and demultiplexing said downstream optical signal into said plurality of downstream channels for output to corresponding ones of the plural subscriber terminals.

12. The bi-directional wavelength division multiplexing system as claimed in claim 6, wherein the remote node includes a multiplexer/demultiplexer for demultiplexing upstream light and a downstream optical signal each for output to the subscriber terminals, the multiplexer/demultiplexer of the remote node multiplexing a plurality of upstream channels having different wavelengths, which are outputted from the subscriber terminals, into said upstream optical signal for transmission to the central office.

13. The bi-directional wavelength division multiplexing system as claimed in claim 12, wherein the multiplexer/demultiplexer of the remote node uses an arrayed waveguide grating demultiplexing upstream light received in the multiplexer/demultiplexer

of the remote node into a plurality of incoherent lights having different wavelengths, demultiplexing said downstream optical signal into said plurality of downstream channels, and outputting the demultiplexed downstream channels and incoherent light to the subscriber terminals.

14. The bi-directional wavelength division multiplexing system as claimed in claim 6, wherein each of the subscriber terminals comprises:

a laser for generating a mode-locked upstream channel by corresponding incoherent light so as to output the generated mode-locked upstream channel;

a photodetector for detecting a corresponding one of the downstream channels; and

a wavelength selection coupler for outputting the mode-locked upstream channel to the remote node, outputting said corresponding one of the downstream channels, which is outputted from the remote node, to the photodetector, and outputting to the laser said corresponding incoherent light.

15. The bi-directional wavelength division multiplexing system as claimed in claim 14, wherein the lasers include Fabry-Perot lasers.

16. A method for multiplexing comprising the steps of:

generating, by corresponding incoherent light received, a plurality of mode-locked channels having different wavelengths;

multiplexing the plural channels into an optical signal for output;

receiving the optical signal; and

amplifying, in a gain saturation state, the received optical signal.

17. The method as claimed in claim 16, further comprising the steps of:

generating light having a wide wavelength band including a plurality of incoherent lights having different wavelengths; and

outputting the multiplexed optical signal for said amplifying, and sending the generated light source for demultiplexing into a plurality of incoherent lights having different wavelengths so as to output the demultiplexed incoherent light among lasers.

18. The method as claimed in claim 17, wherein said generating light having a wide wavelength band is performed by a broadband light source that includes an Erbium-doped fiber amplifier.

19. The method as claimed in claim 16, wherein the multiplexing is performed by a multiplexer/demultiplexer that includes an arrayed waveguide grating.

20. The method as claimed in claim 16, wherein the generating is performed by lasers that include a Fabry-Perot laser for generating a respective mode-locked channel by incoherent light.